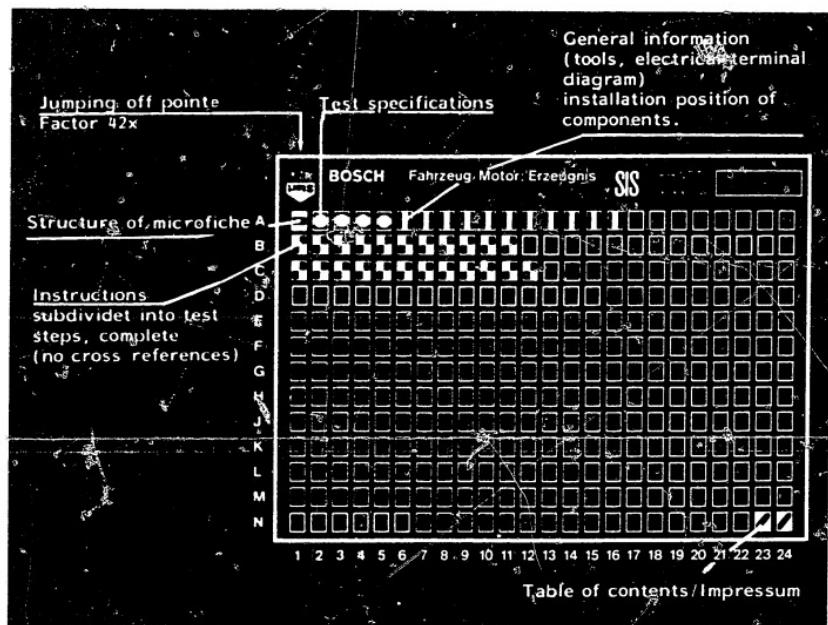
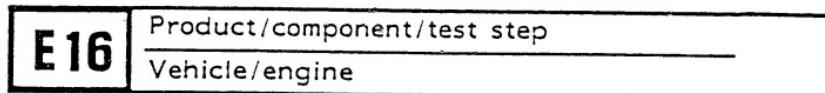


Structure of microfiche



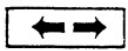
1. Read from left to right
2. Title of microfiche (appears on each coordinate)



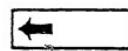
3. Limits of section



Beginning



Mid-section



End



One-page section

4. References to relevant test steps in test specifications; coordinate e.g. C6



A1

Repair and testing



Caution!



When working on systems from 40 V d.c. upward, proceed in accordance with the general local safety regulations.



1. Test specifications

Overvoltage protection:

Response voltage	U_s	= 53.0 ... 55.0 V
Time delay	t_s	= 6.0 ... 20 μ sec
Voltage limitation	$D+/D-$	≤ 75 V
Test voltage	U_p	= 79.0 V ... 81.0 V

Consequential-damage protection:

Response voltage	U_F	= 31.0 ... 32.0 V
Time delay	t_F	= 1.0 ... 5.0 sec
Test voltage	U_p	= 32.9 ... 33.1 V

Voltage limitation:

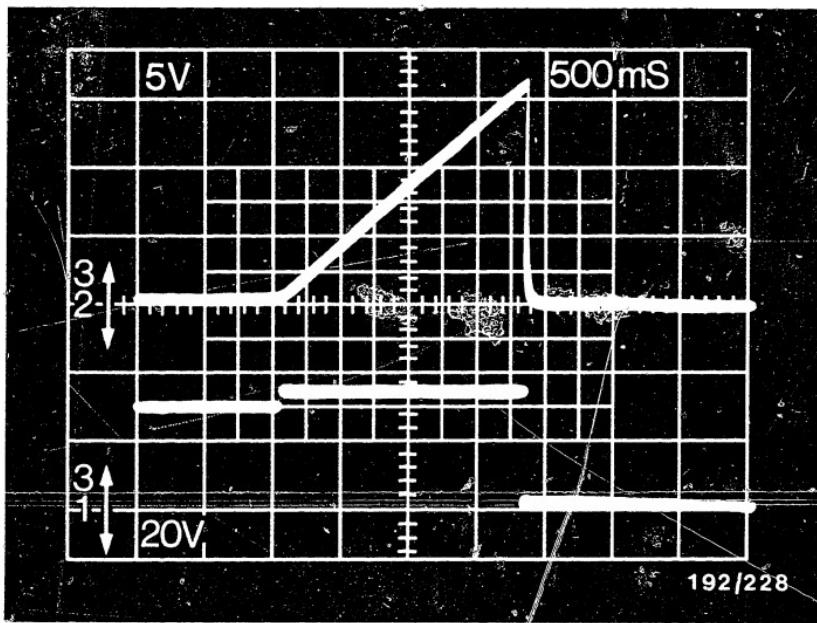
Test voltage	U_p	= 80 V
Voltage between		
$D+$ and $D-$		≤ 75 V

A2

Test specifications

Overvolt./conseq.dam.prot. 0 192 900 008

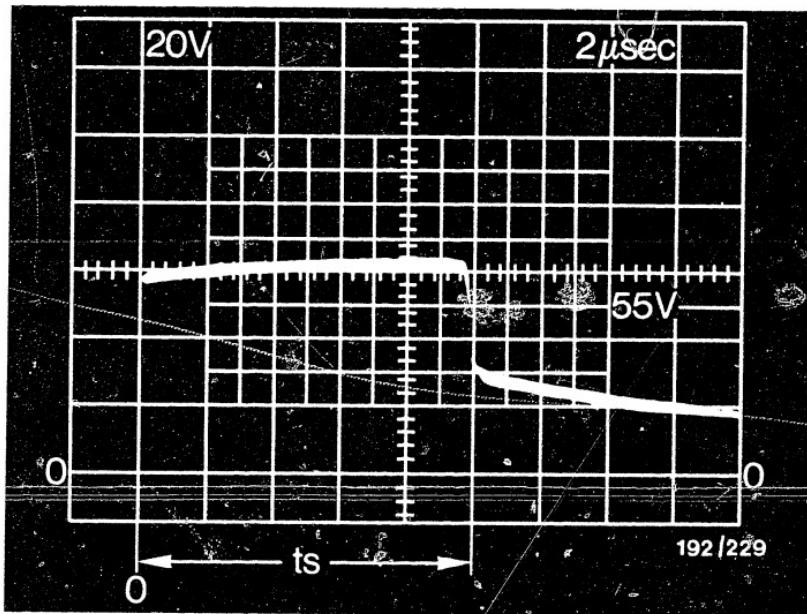




- 1 = Base line on oscilloscope - channel 1
- 2 = Base line on oscilloscope - channel 2
- 3 = Positive

Oscilloscope pattern - consequential-damage protection

OK oscilloscope pattern of measuring point 3 (C2) and measuring point 2 (D+)



- 1 = Base line on oscilloscope
- 2 = Negative
- 3 = Positive

Oscilloscope pattern - overvoltage protection

OK oscilloscope pattern of measuring point 2 (D+)



2. Test equipment, lubricants

2.1 Test equipment

Measuring oscilloscope Commercially available

(Resolution 25 MHz
smallest measuring range
5mV/cm time-delay cable)
(e.g. Hameg 412)

Voltmeter

(Measuring range up to 100 V) Commercially available

Ohmmeter

(Measuring range 1 MΩ)
(e.g. Bosch Electric-
Tester ETE 014.00
Part No. 0 684 101 400)

Voltage stabilizer

(80 V min. 2 A) (e.g. Zentro Electric)

Resistance decade

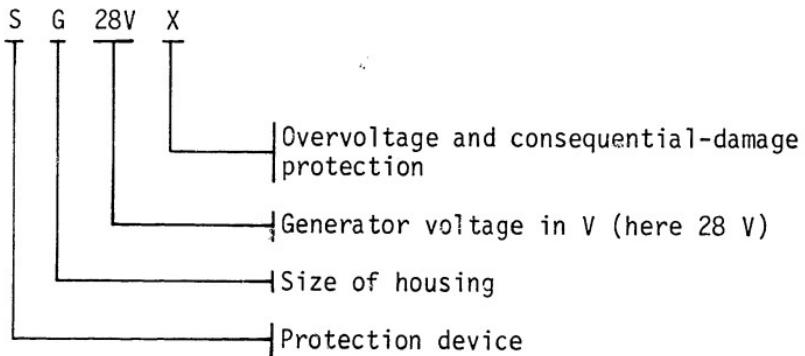
Commercially available

2.2 Lubricants

Thermo-lubricant Part No. 5 942 860 003



3. Explanation of type code

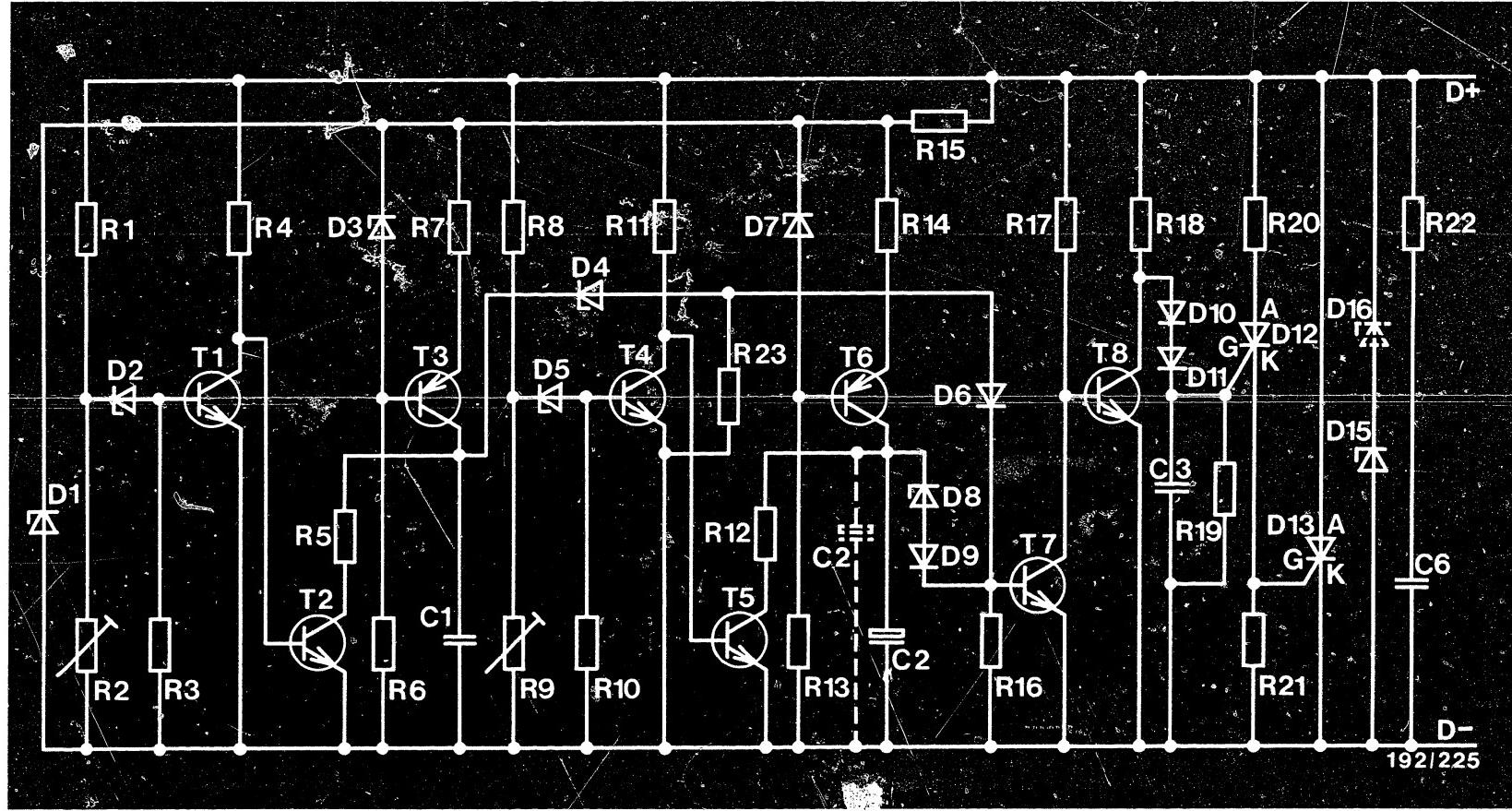


A6

Type code

Overvolt./conseq.dam.prot. 0 192 900 008





4. Internal circuit diagram of overvoltage/consequential damage protection device U 192 900 008 (S G 28V X)

D+, D- = Leads for connection of overvoltage protection

A7

Internal circuit diagram

Overvolt./conseq.dam.prot. 0 192 900 008

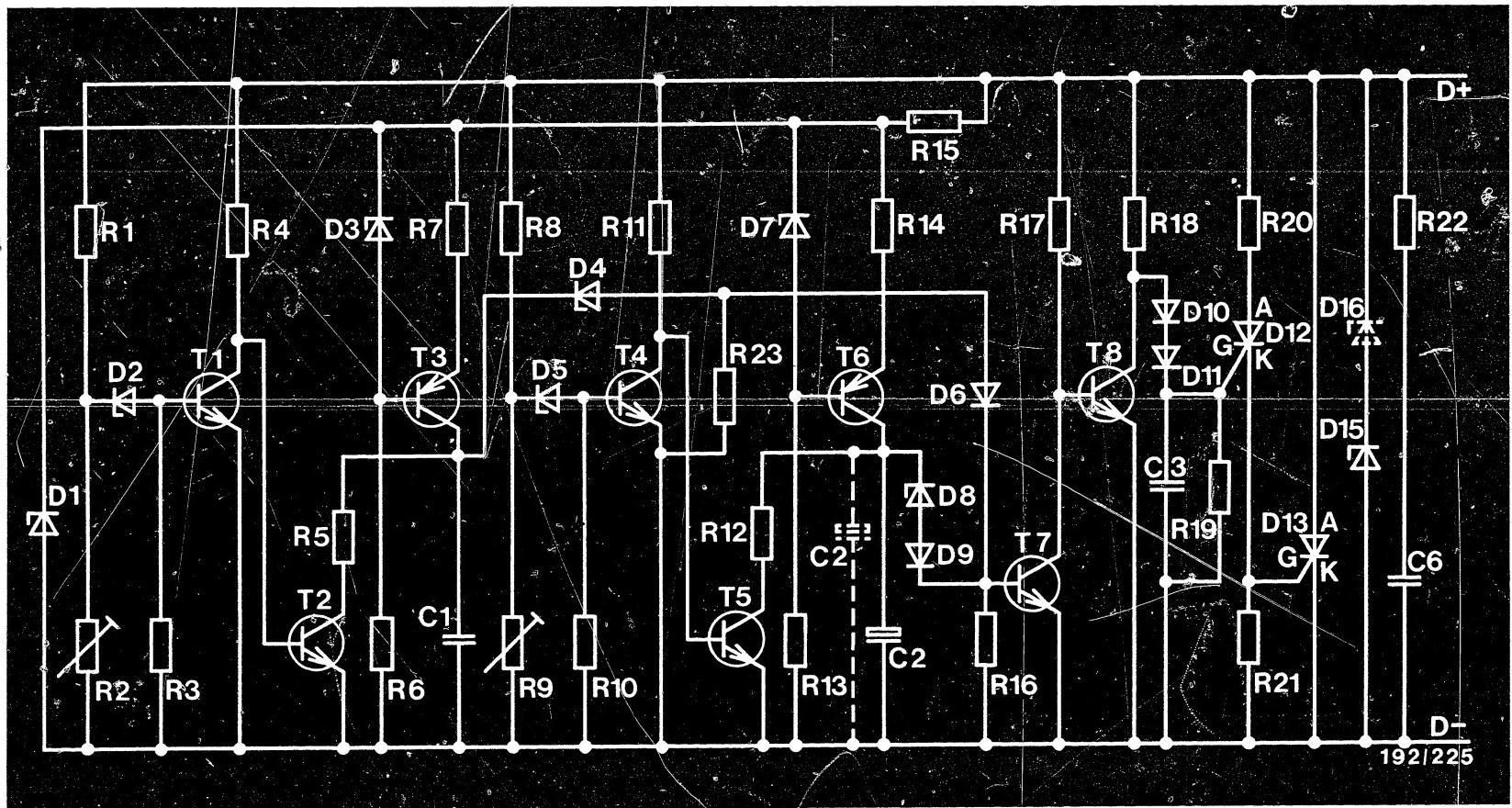


A8

Internal circuit diagram

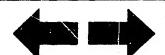
Overvolt./conseq.dam.prot. 0 192 900 008

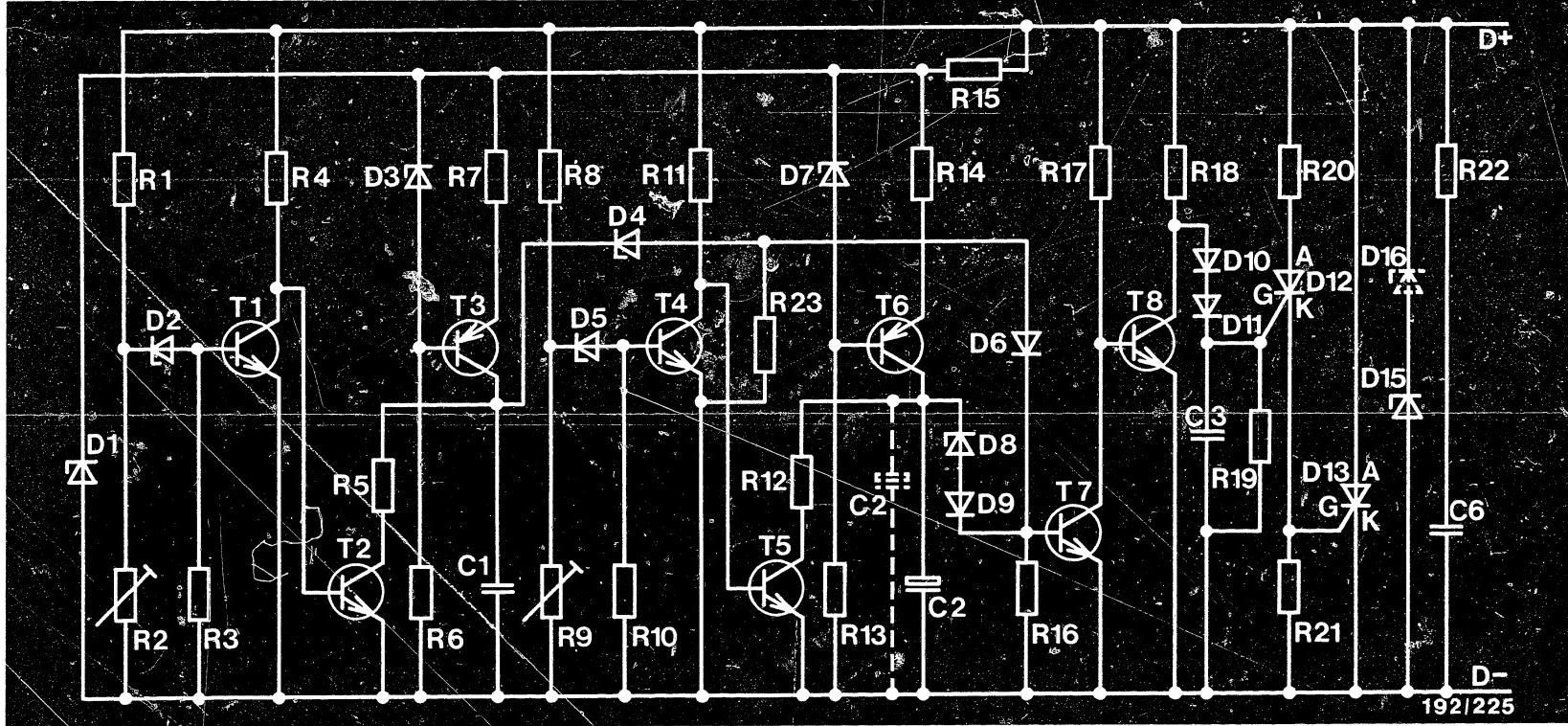




A9 Functional description
Overvolt./conseq.dam.prot. 0 192 900 008

A10 Functional description
Overvolt./conseq.dam.prot. 0 192 900 008





If voltage $D+$ is lower than the response voltage U_S set at the overvoltage protection device, transistor T 1 blocks. T 2 conducts and prevents the charging of capacitor C 1. Transistor T 7 blocks; T 8 conducts, D 12 and D 13 block.

If voltage $D+$ is greater than U_S , T 1 conducts, T 2 blocks. Capacitor C 1 is charged by the power source T 3, D 3, R 6, R 7.

If voltage of unidirectional-breakdown diode D 4, D 6, U_{BE} , T 7 is reached (\geq time delay), transistor T 7 conducts, T 8 blocks and triggers thyristor D 12.

Thyristor D 12 delivers a large grid current for D 13. This shortens the switching time of D 13. D 13 short-circuits $D+$ and $D-$.

A11

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



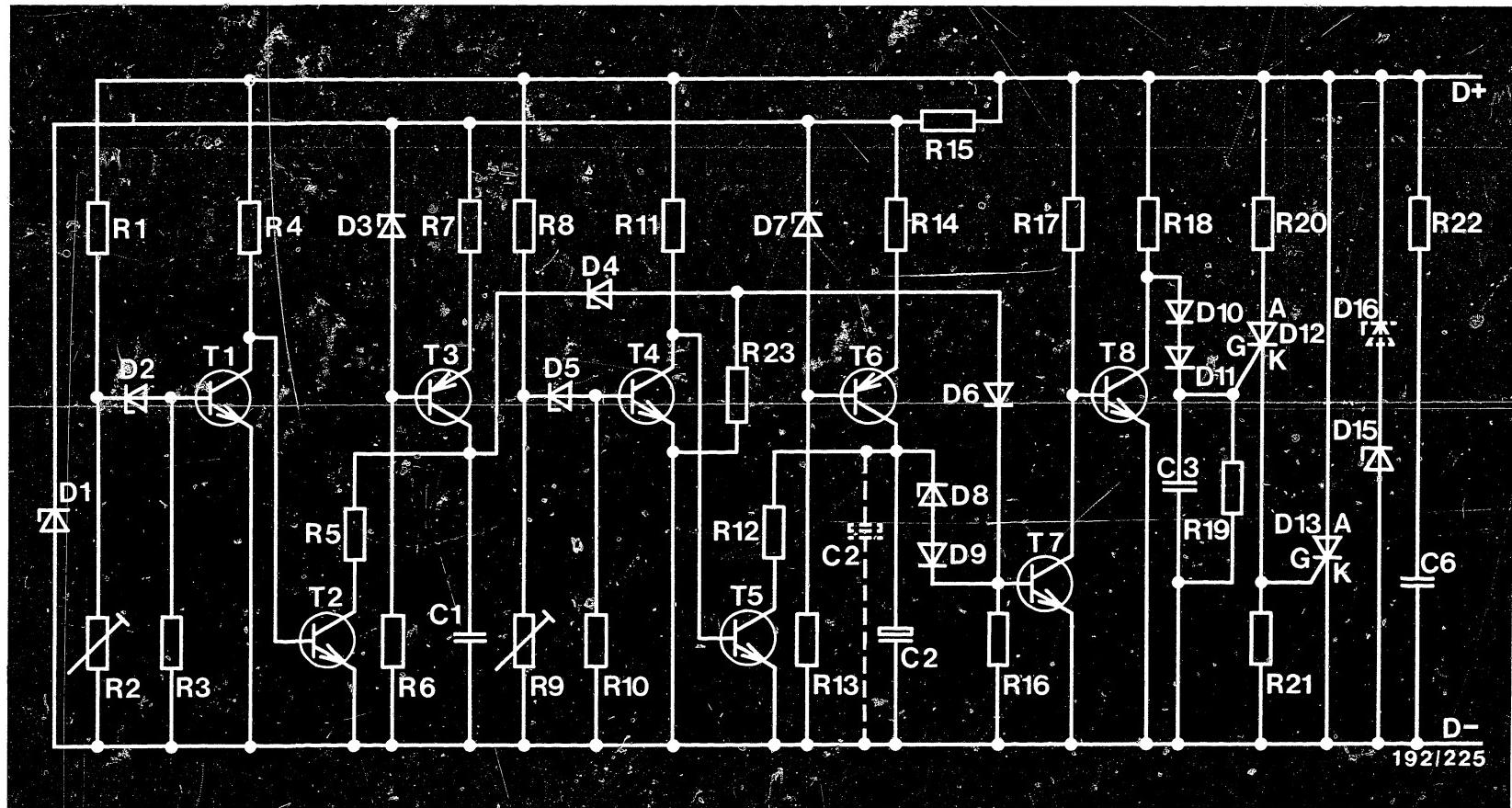
A12

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



192/225



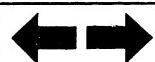
If the time of the overvoltage is shorter than the time delay, transistor T 1 blocks and capacitor C 1 is discharged through transistor T 2, i. e. T 7 remains blocked, T 8 continues to conduct. D 12 and D 13 are not triggered. D 15 limits the voltage across D+ and D- to ≤ 80 V for a maximum of 20 μ sec.

Short circuit between D+ and D- can only be remedied by shutting down the generator.

A13

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008

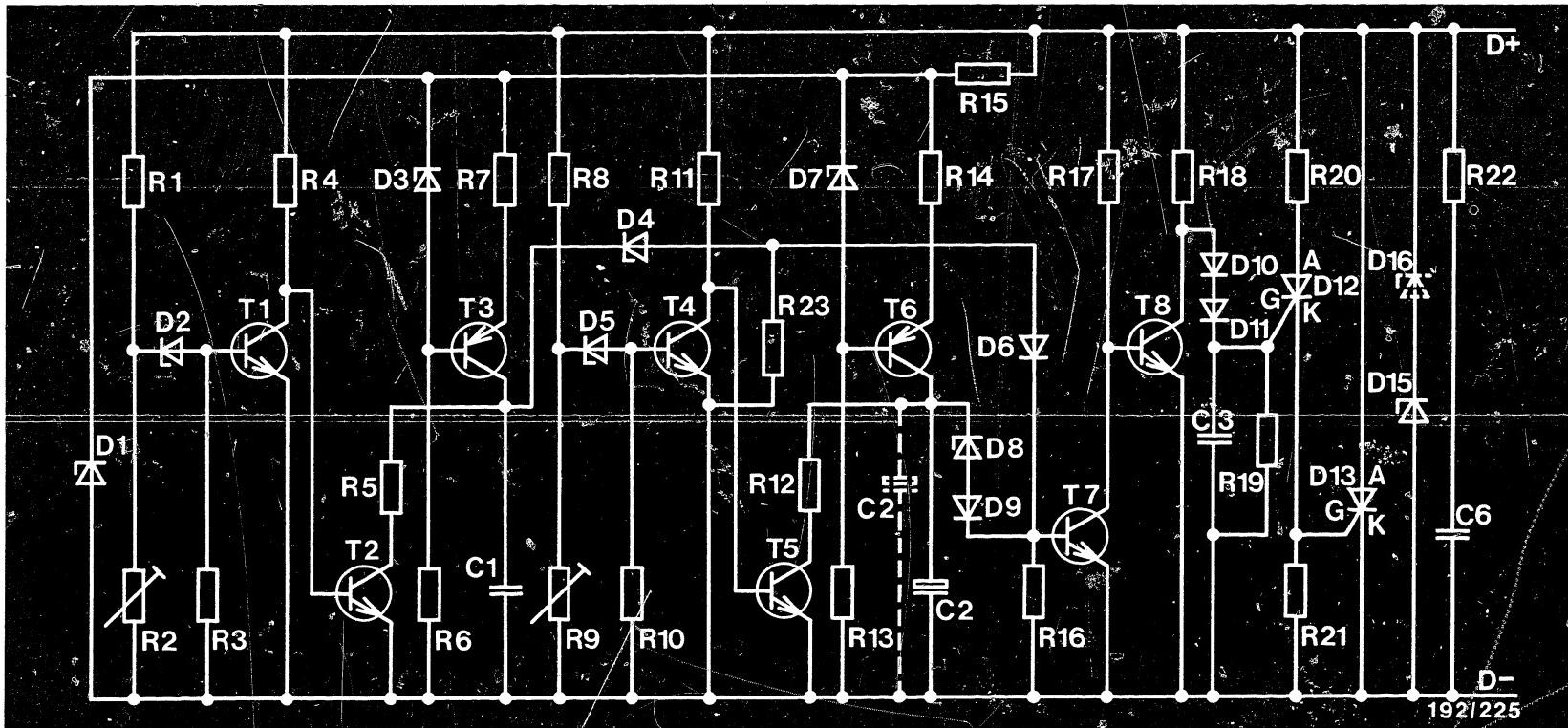


A14

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008





5.2 Consequential-damage protection

The consequential-damage protection device protects the battery against overcharging if the regulator, although conducting, is defective. If the response voltage U_F set at R 9 is exceeded, T 4 conducts, T 5 blocks. C 2 is charged by the power source T 6, D 7, R 14. If the voltage across capacitor C 2 reaches $U_{D8} + U_{D9} + U_{BE7}$, T 7 conducts, T 8 blocks, D 12 and D 13 fire and short-circuit the generator between D+ and D-.

Short-circuit between D+ and D- can only be remedied by shutting down the generator.

A15

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008


A16

Functional description

Overvolt./conseq.dam.prot. 0 192 900 008



✓ 6. Trouble-shooting

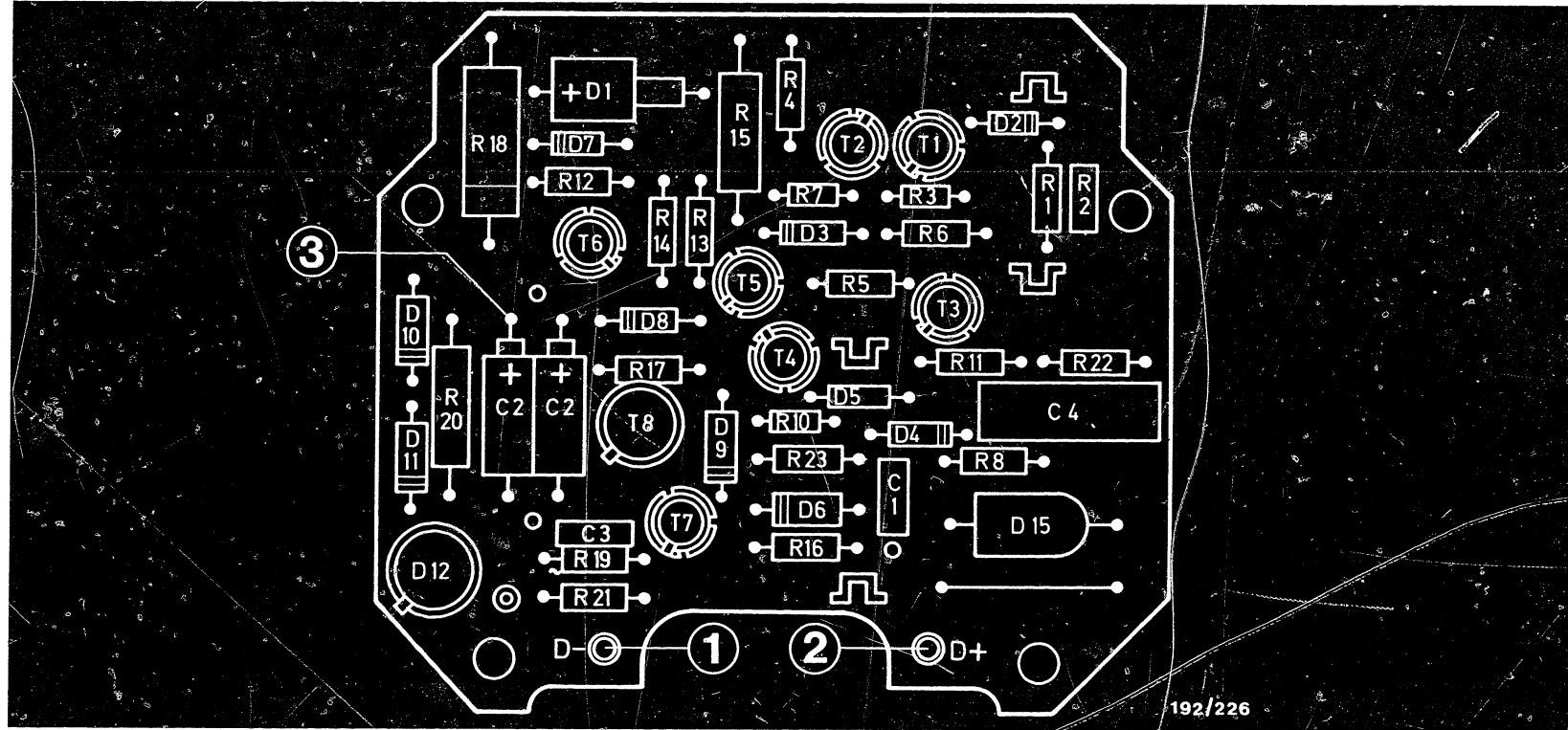
6.1 Visual examination

By means of a visual examination, establish whether a component has an immediately recognizable defect. Burnt-off connections are not to be repaired; instead, renew the entire printed-circuit board.

6.2 Insulation test

Using ohmmeter, test whether power thyristor D 13 is correctly insulated from the heat sink and the regulator housing. Resistance value min. 1 MΩ. Renew defective insulating washers. Apply thermal-conduction paste to both sides of insulating washer.





6.3 Trouble-shooting with oscilloscope

To quickly locate a fault, it is practical to test the overvoltage and consequential-damage protection device with an oscilloscope. Operate the oscilloscope only through an isolating transformer.

Measuring points for trouble-shooting with voltage stabilizer and oscilloscope.

Measuring point 3 = + Terminal on capacitor C 2

Measuring point 1 = Reference potential

Measuring point 2 = D+ terminal

B2

Trouble-shooting

Overvolt./conseq.dam.prot. 0 192 900 008

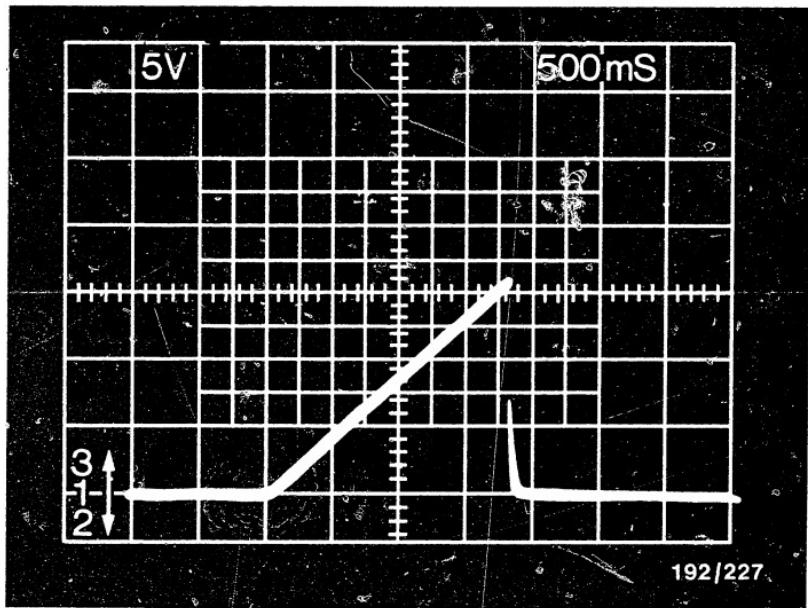


B3

Trouble-shooting

Overvolt./conseq.dam.prot. 0 192 900 008

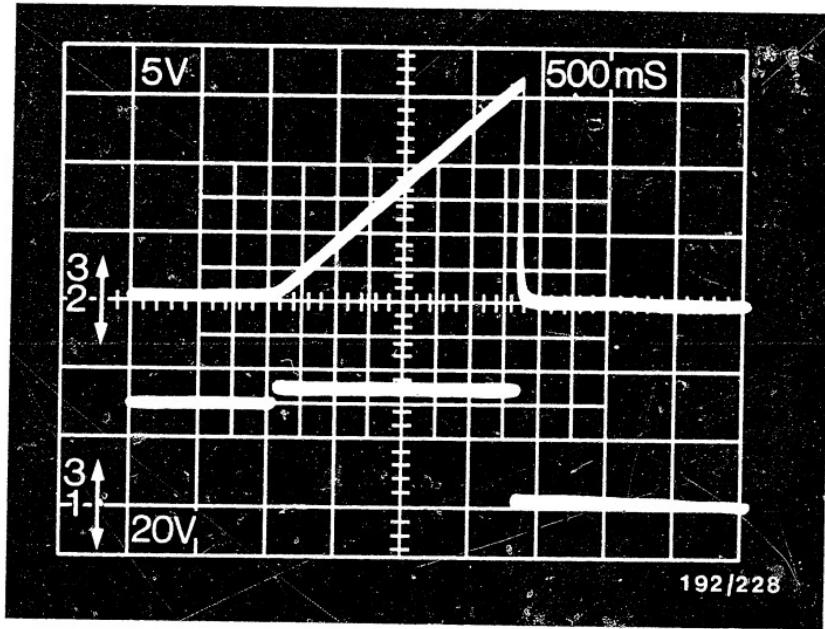




- 1 = Base line on oscilloscope
- 2 = Negative
- 3 = Positive

Oscilloscope pattern - consequential-damage protection

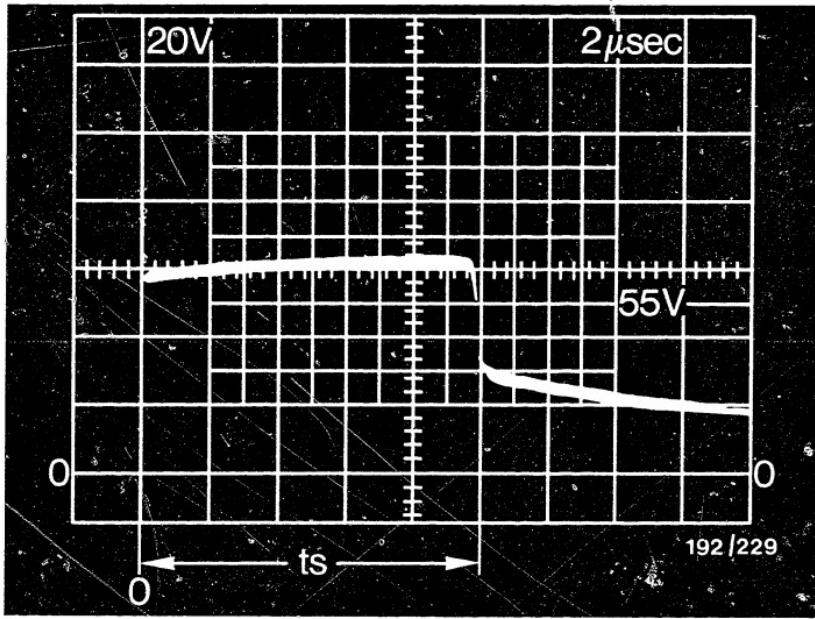
OK oscilloscope pattern of measuring point 3 (capacitor C 2)



- 1 = Base line on oscilloscope - channel 1
 2 = Base line on oscilloscope - channel 2
 3 = Positive

Oscilloscope pattern - consequential-damage protection

OK oscilloscope pattern of measuring point 3 (C 2) and measuring point 2 (D+)



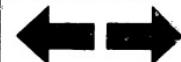
1 = Base line on oscilloscope

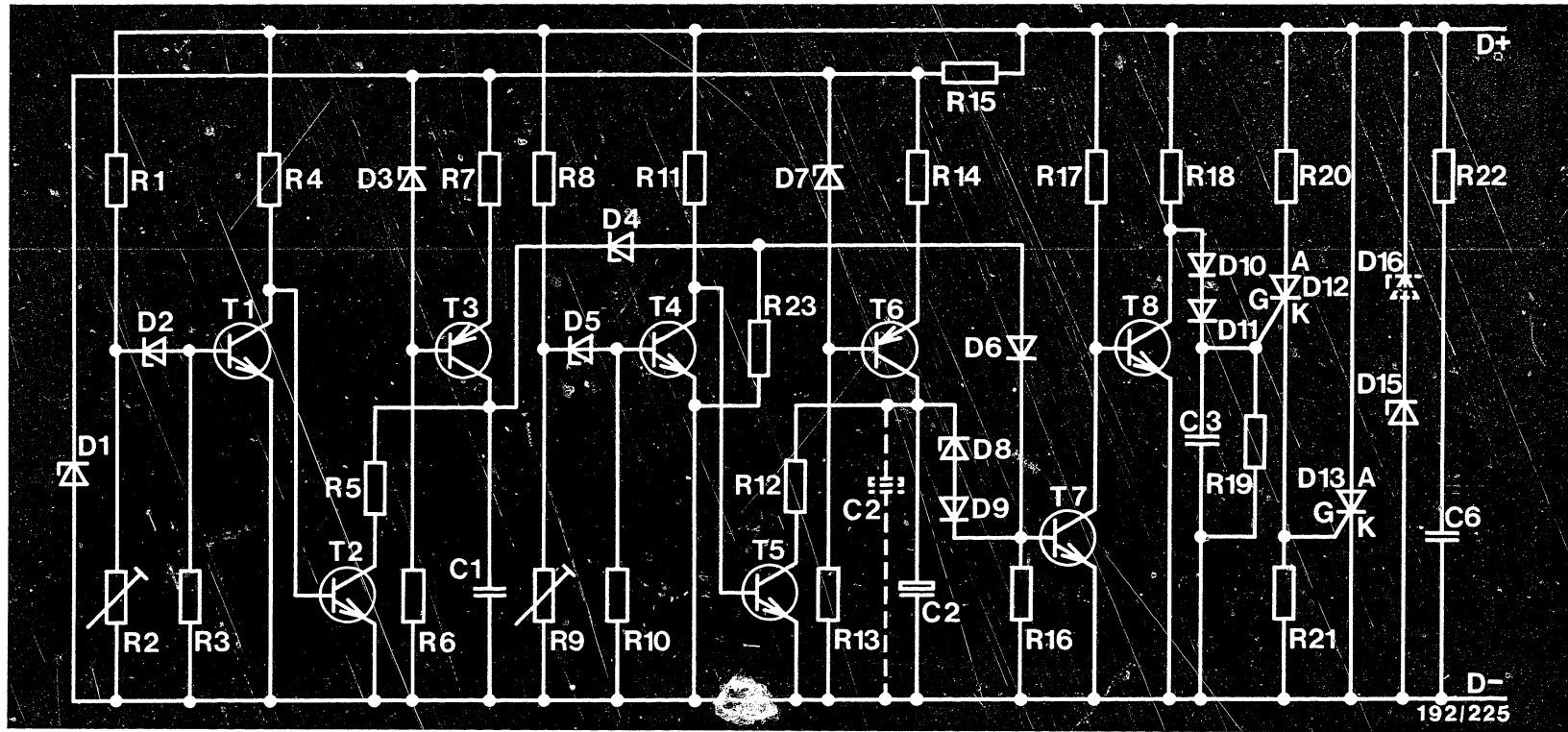
2 = Negative

3 = Positive

Oscilloscope pattern - overvoltage protection

OK oscilloscope pattern of measuring point 2 (D+)





192/225

6.4 Notes on possible faults

Overvoltage protection responds immediately when generator is started:

U_{D+} must be present (generator operating)

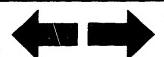
Possible faults:

Unidirectional-breakdown diode D 2 conducting, transistor T 1 conducting, T 2 blocks.
T 7 conducts, T 8 blocks, thyristors D 12 and D 13 conduct.

B7

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008

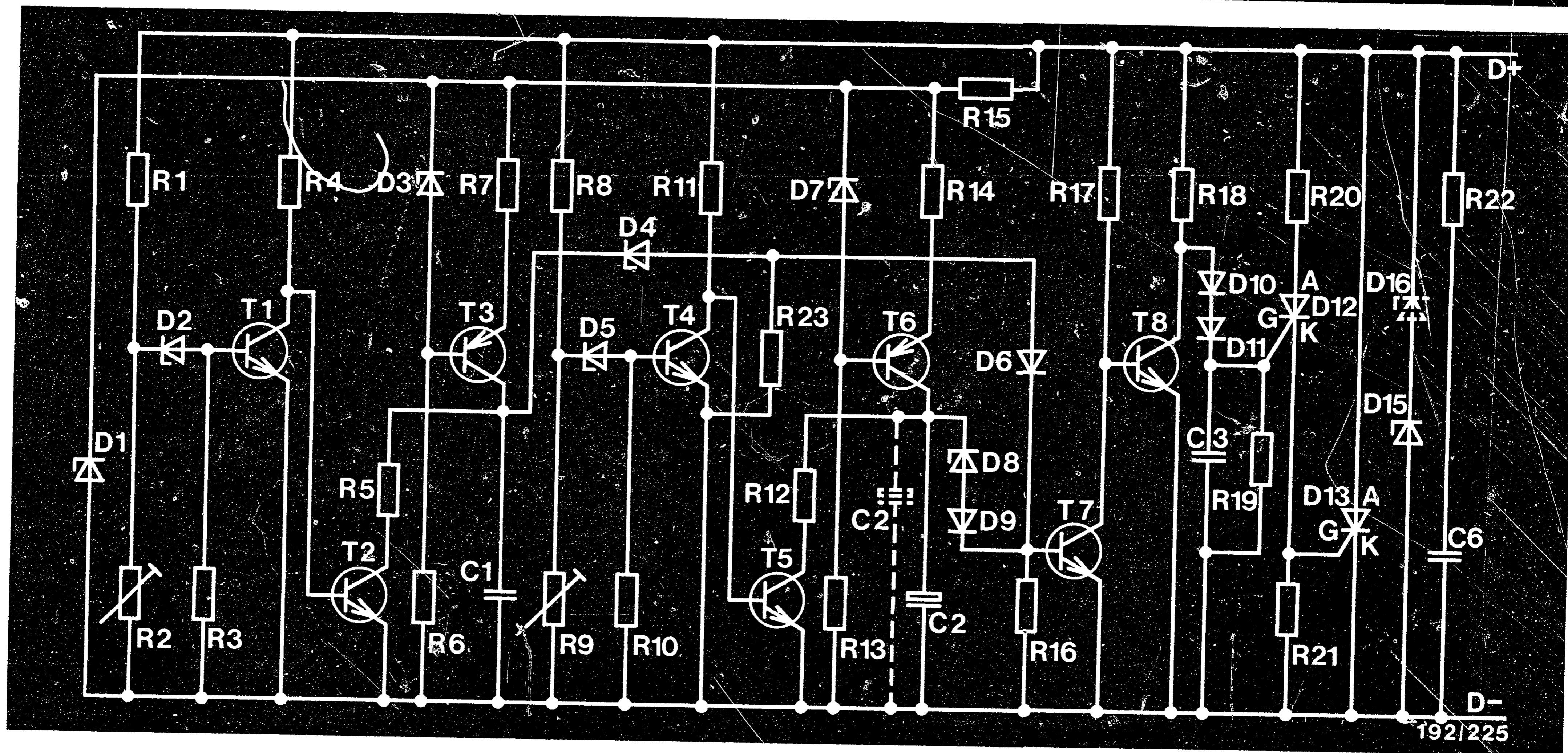


B8

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008





Consequential-damage protection responds immediately when generator is started:

U_{D+} must be present, generator operating

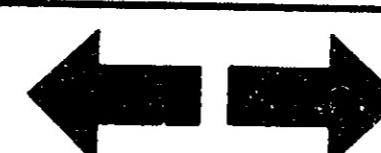
Possible faults:

Unidirectional-breakdown diode D 5 conducts, transistor T 4 conducts, T 5 blocks,
T 7 conducts, T 8 blocks, thyristors D 12 and D 13 conduct.

B9

Trouble-shooting program

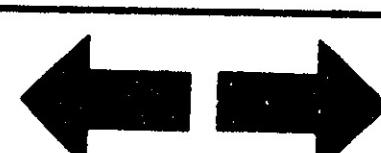
Overvolt./conseq.dam.prot. 0 192 900 008

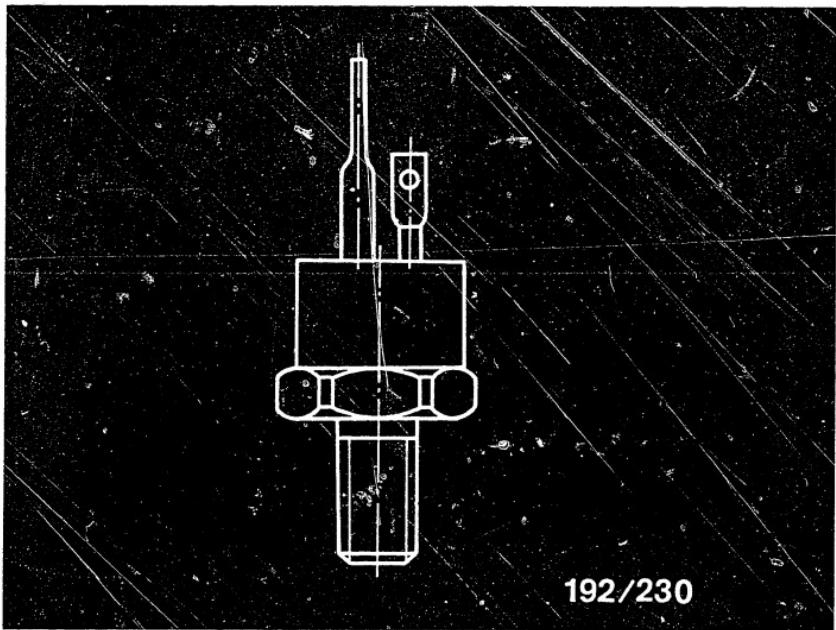


B10

Trouble-shooting program

Overvolt./conseq.dam.prot. 0 192 900 008





192/230

6.5 Notes on renewing individual components

Mark leads so that connections are not mixed up when assembling.

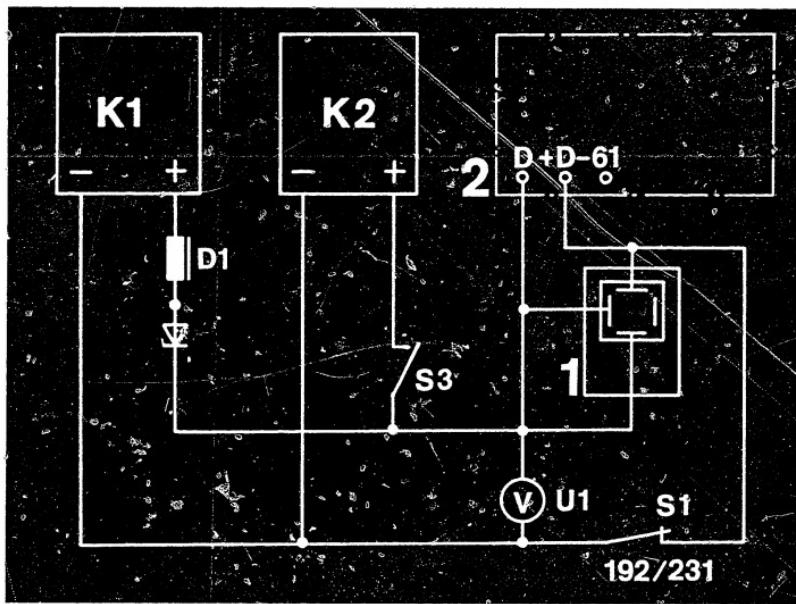
Do not heat semiconductor devices when soldering. To dissipate heat, hold the connecting wire behind the soldered joint with pointed pliers or pincers. After unsoldering a defective component, remove (extract) excess solder from the holes of the printed-circuit board. When soldering in, do not apply too much solder.

Caution: For soldering, use only colophonium tin, under no circumstances use paste-type soldering flux.

To remove thyristor D 13, first of all unsolder connecting wires.

Make sure that the housing of the overvoltage and consequential-damage protection device is not contacted by fanned-out wire leads.





K 1 = Voltage stabilizer 0 ... 50 V max. 2 A

K 2 = Voltage stabilizer 0 ... 80 V max. 1 A

S 1 = Nonlocking switch with normally-closed contact

S 3 = Nonlocking switch with normally open contact
(chatter-free)

D 1 = Inductor L approx. 2 mH

1 = Oscilloscope

2 = Object under test (0 192 900 008)

7. Testing

7.1 Test circuit for overvoltage and consequential-damage protection

Make up test circuit as in diagram. Set current limitation to 2 A at voltage stabilizer K 1, and to 1 A at voltage stabilizer K 2.

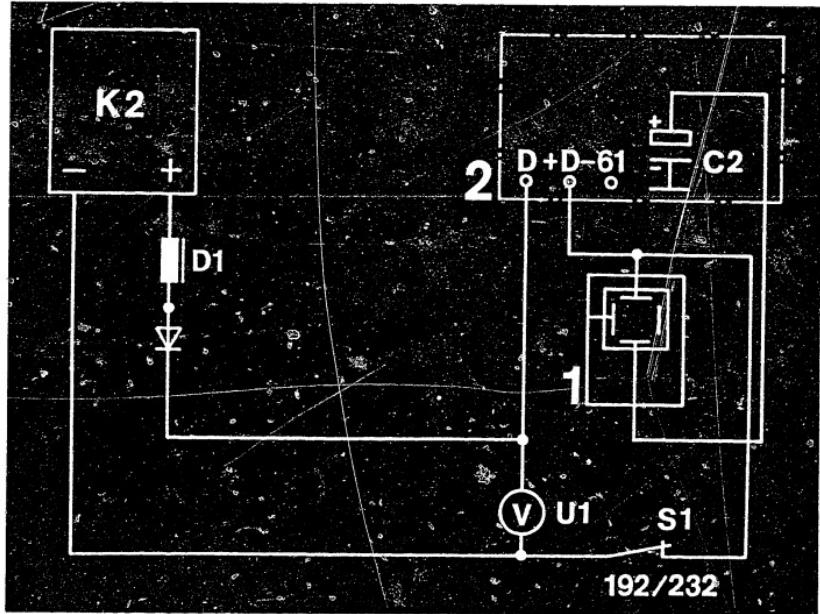
The test circuit is switched on with switch S 1.

C1

Testing

Overvolt./conseq.dam.prot. 0 192 900 008





K 2 = Voltage stabilizer 0 ... 80 V max. 1 A

S 1 = Nonlocking switch with normally-closed contact

D 1 = Inductor L approx. 2 mH

1 = Oscilloscope

2 = Object under test (0 192 900 008)

7.2 Testing the overvoltage protection:

Short-circuit trimming resistor R 9.

Connect voltage stabilizer K 2 to overvoltage and consequential-damage protection device.

Slowly increase voltage at voltage stabilizer K 2.

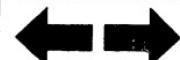
At 53.0 V to 55.0 V overvoltage protection device must respond.

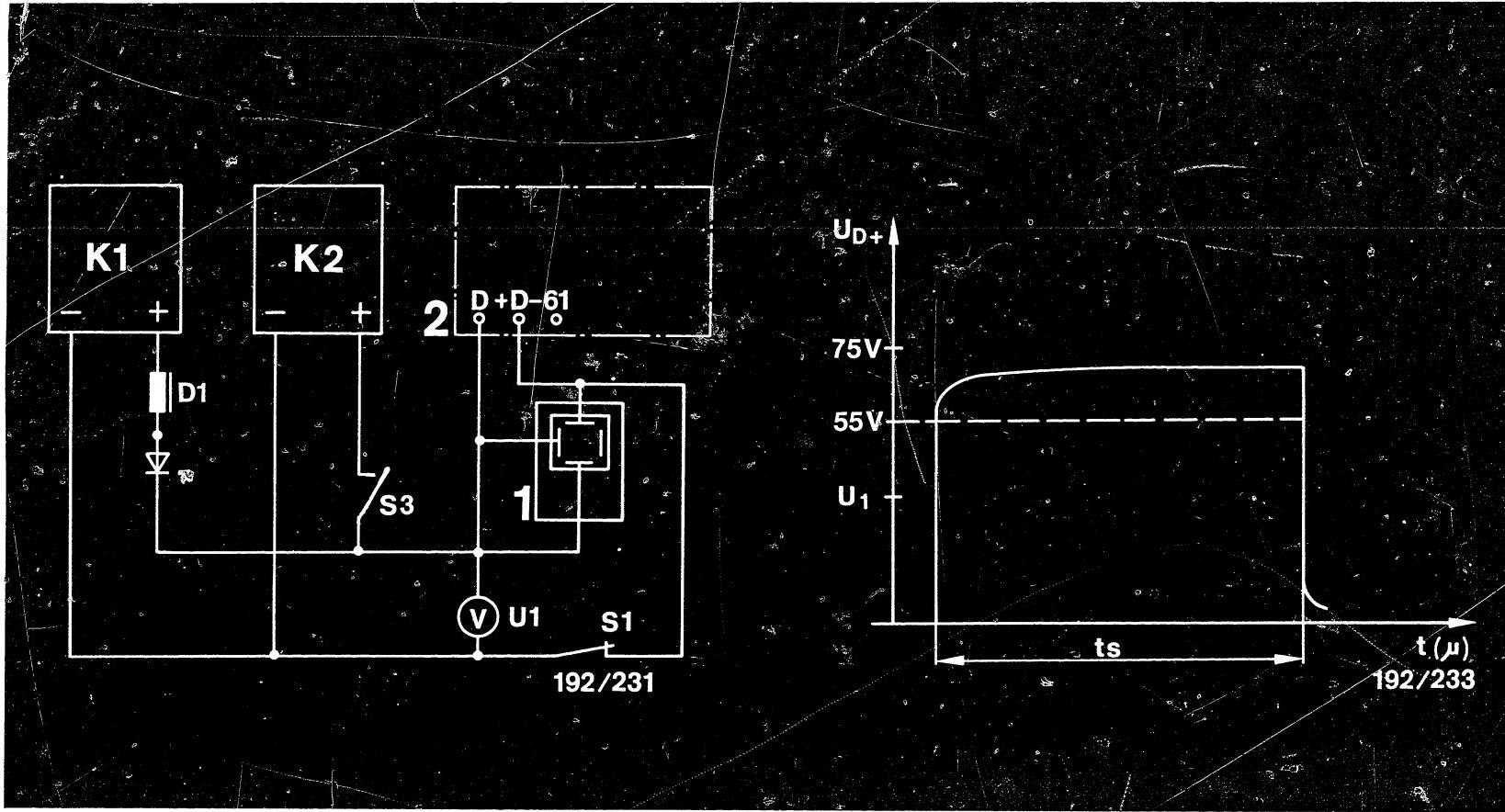
Voltage stabilizer K 2 is short-circuited.

C2

Testing

Overvolt./conseq.dam.prot. 0 192 900 008





7.3 Testing the delay time of the overvoltage protection device

Connect oscilloscope according to test circuit.

Set voltage at voltage stabilizer K 1 to 28.0 V, and at voltage stabilizer K 2 to 80 ± 0.1 V.

Time delay (t_s) between switching-on of nonlocking switch S 3 and dropping of voltage U_1

can be read off on the oscilloscope screen. The set value for the time delay is 0.006...0.02 ms.

The operation can be repeated by pressing button S 1.

C3

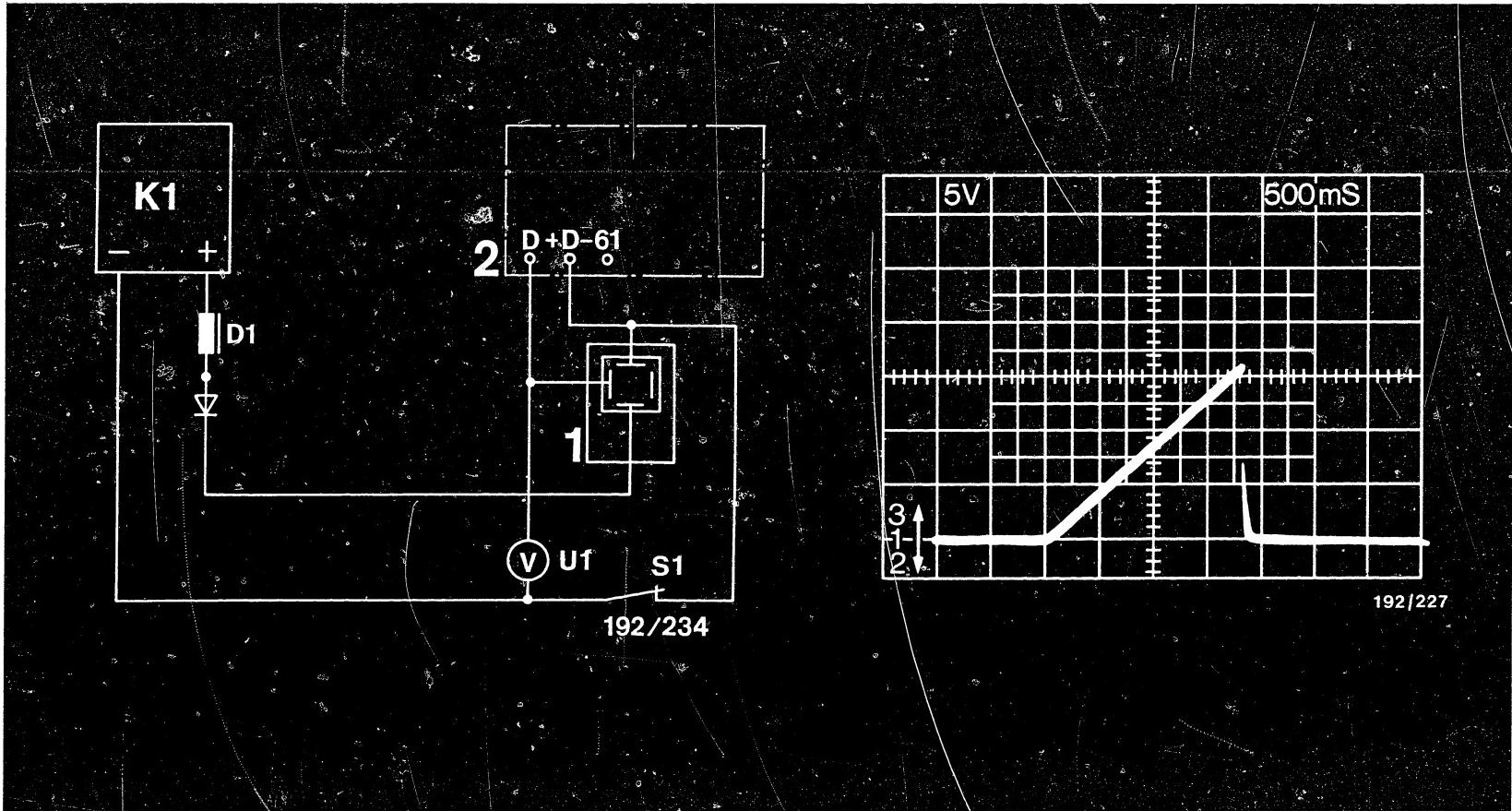
Testing
Overvolt./conseq.dam.prot. 0 192 900 008



C4

Testing
Overvolt./conseq.dam.prot. 0 192 900 008





7.4 Testing the consequential-damage protection device

Connect voltage stabilizer K 1 to overvoltage and consequential-damage protection device. Connect oscilloscope to D+ (measuring point 2) of overvoltage and consequential-damage protection device.

Slowly increase voltage at voltage stabilizer K 1. Voltage at measuring point 2 rises (see picture). Between 31.0 and 32.0 V the consequential-damage protection device must respond. Voltage curve can be read off on oscilloscope screen (see picture).

OK oscilloscope pattern of measuring point 3

- 1 = Base line
- 2 = Negative
- 3 = Positive

C5

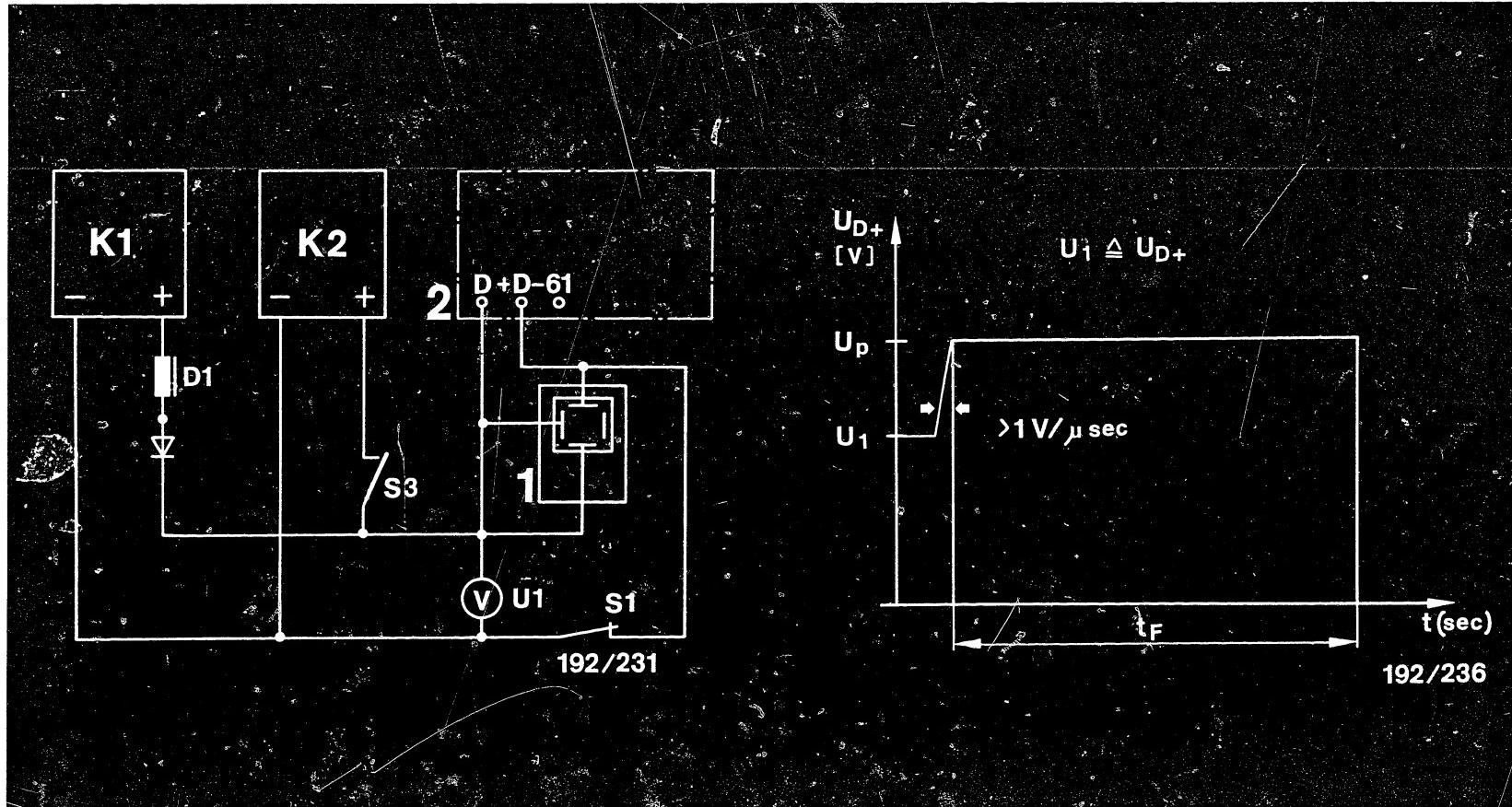
Testing
Overvolt./conseq.dam.prot. 0 192 900 008



C6

Testing
Overvolt./conseq.dam.prot. 0 192 900 008





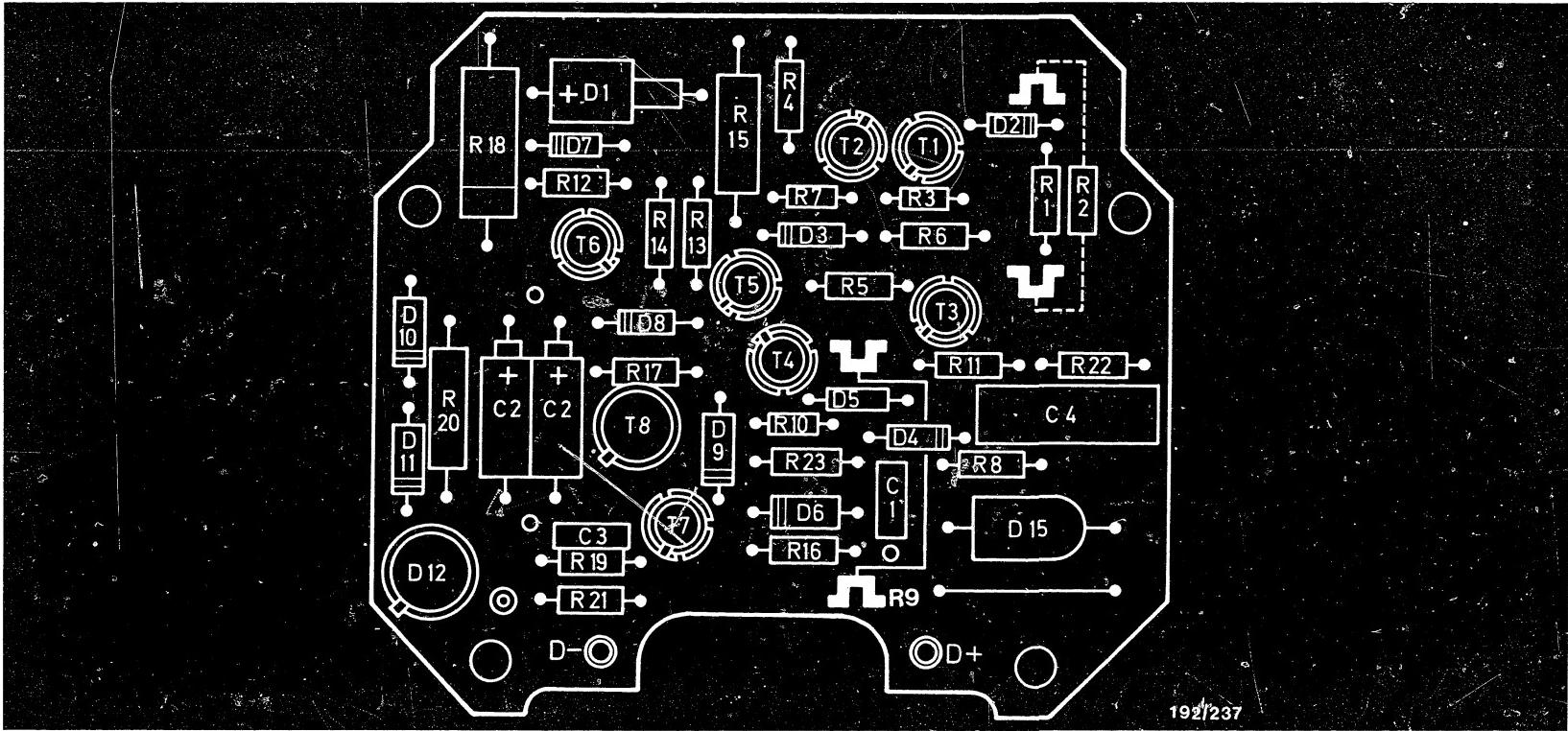
7.5 Testing the delay time of the consequential-damage protection device

Connect oscilloscope according to test circuit.

Set voltage at voltage stabilizer K 1 to 28.0 V, and at voltage stabilizer K 2 to 33.0 V.

The time delay t_F between switching on of nonlocking switch 53 and dropping of voltage U_1 can be read off on the oscilloscope screen. The set value for the time delay is 1 - 5 sec.

The operation can be repeated by pressing nonlocking switch T 1.



8. Setting

8.1 Setting the overvoltage protection device

The overvoltage protection device is trimmed with resistor R 2. Short-circuit trimming point R 9. Connect resistance decade to trimming point R 2. Setting on resistance decade 0Ω . Connect overvoltage protection device to voltage stabilizer and set a voltage of 53.0 V - 55 V. Increase resistance at resistance decade until the thyristor fires and short-circuits the setting voltage. Install fixed resistor of same value as reading. By changing the response voltage, check whether the installed resistor meets the response voltage requirement.

C9

Setting the overvoltage protection

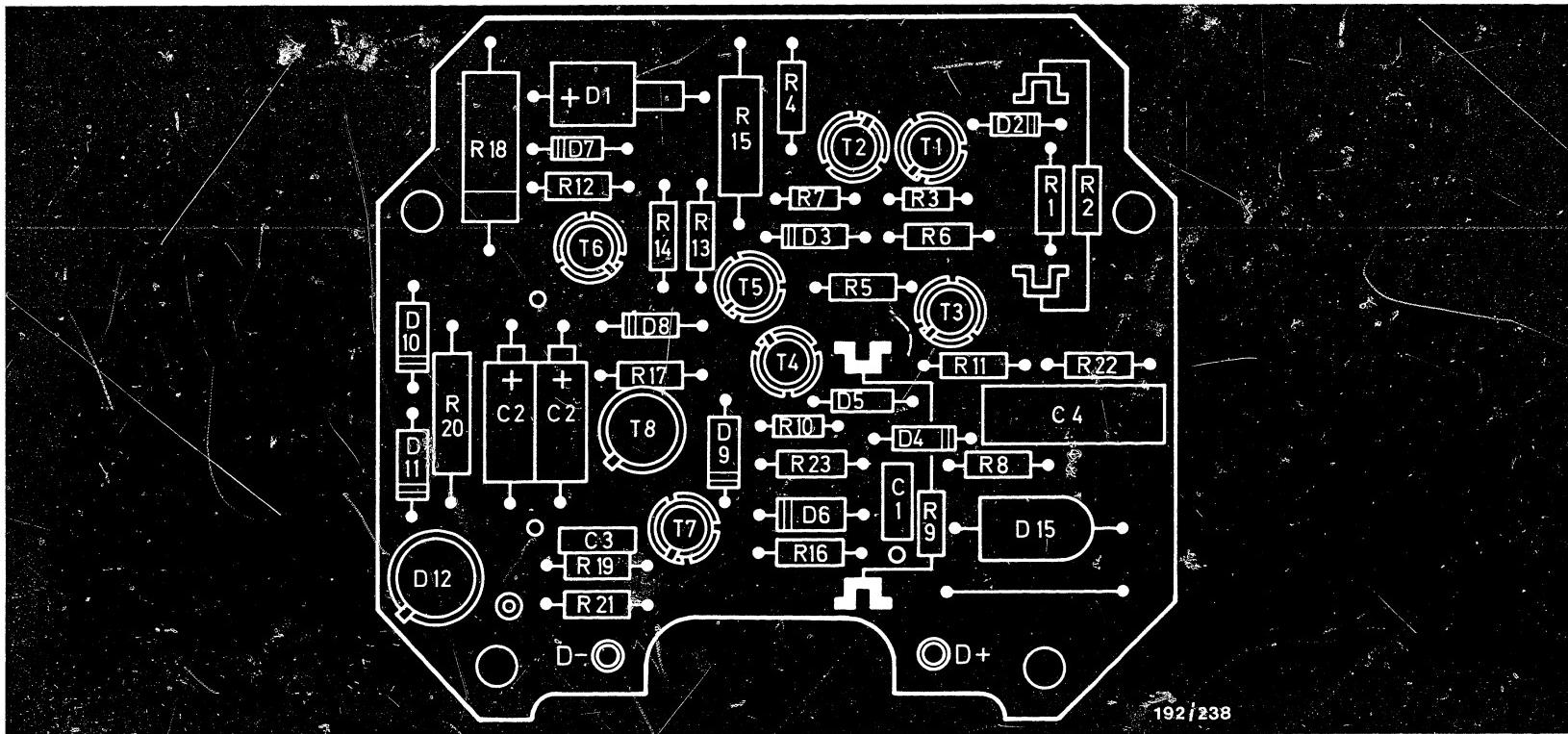
Overvolt./conseq.dam.prot. 0 192 900 008


C10

Setting the overvoltage protection

Overvolt./conseq.dam.prot. 0 192 900 008





8.2 Setting the consequential-damage protection device

The consequential-damage protection device is trimmed with resistor R 9. Connect resistance decade to trimming point R 9. Setting at resistance decade 0 Ω . To make setting easier, an oscilloscope is connected to + terminal of capacitor C 2 (voltage reading approx. 0 V). When the value of the trimming resistor is increased and the response voltage is reached, the voltage across the capacitor begins to rise. On resistance decade, read off resistance value which causes the voltage across the capacitor to rise, and install fixed resistor of this value.

By changing the response voltage, check the setting of the consequential-damage protection device.

C11

Setting the consequent.-damage protection
Overvolt./conseq.dam.prot. 0 192 900 008



C12

Setting the consequent.-damage protection
Overvolt./conseq.dam.prot. 0 192 900 008



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Automotive Equipment - After-Sales Service
Department for Technical Publications KH/VDT,
Postfach 50, D-7000 Stuttgart 1

Published by: After-Sales Service Department for Training and Technology (KH/VSK). Press date: 6.1984
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Microfilmed in the Federal Republic of Germany. Micro-photographi  en R  publique F  d'Allemagne.

